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**ELECTRONIC SPECTACLES**

**Pub. No.:** 55-076323 [JP 55076323 A ]
**Published:** June 09, 1980 (19800609)
**Inventor:** TOMITA TADAHARU
**Applicant:** SEIKO EPSON CORP [000236] (A Japanese Company or Corporation), JP (Japan)
**Application No.:** 53-149497 [JP 78149497]
**Filed:** December 01, 1978 (19781201)
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**JAPIO Keyword:** R011 (LIQUID CRYSTALS)
**Journal:** Section: P, Section No. 25, Vol. 04, No. 122, Pg. 33, August 29, 1980 (19800829)

**ABSTRACT**

PURPOSE: To eliminate defects such as aberrations and swings of images during wearing, conspicuousness of boundary lines of lenses and others by subjecting a portion of the spectacle lenses electrically to refractive index controlling.

CONSTITUTION: A small ball which is capable of controlling refractive indices is inserted in the near-vision part and intermediate-vision part of a spectacle lens. Namely, the small ball is inserted at the faying surface 3 of lenses 1, 2. The shape of the small ball for near-vision may be circle, segment, ellipse, etc. and its surface curve is preferably ellipsoid of revolution and surface of revolution of n-degrees, in order to reduce the aberrations of the lens. Transparent electrodes are coated on the lens 1 and 2 in contact with the small ball 4. These are mutually insulated and lead wires 5, 6 are led out from the respective transparent electrodes. The lead wires are connected to a power source which applies voltage and current to the small ball part and changes its refractive index. Liquid crystal is put in a cavity part 4. In this way, the refractive index may be changed continuously or stepwise.

PTO 2002-2554

Japanese Kokai Patent Publication S55-76323, published June 9, 1980; Application No. S53-149497, filed December 1, 1978; Inventor: Tadaharu TOMITA; Assignee: KK Suwa Seikosha (Seiko Epson Corporation)

# ELECTRONIC SPECTACLES

## Claims

[Claim 1]

Electronic spectacles characterized in that the refractive index of the near-vision part is electrically adjusted.

[Claim 2]

Electronic spectacles characterized in that, with electronic spectacles whereby the refractive index of the near-vision part is electrically adjusted, the refractive index of the intermediate-vision part is electrically adjusted.

## Detailed Explanation of the Invention

The present invention concerns electronic spectacles for presbyopia; in particular, it is characterized in that the refractive indices of the near-vision and intermediate-vision parts are electrically adjusted.

With presbyopia, because adjusting abilities decline due to the constriction and relaxation of the ciliary muscles, the extent to which one can see is limited. Specifically, when the human body is 40 years of age or older, the ability of the eyes to adjust decreases, and near- and medium-range focusing cannot be carried out.

To aid in the declining of the adjusting ability, so-called farsighted glasses are available to recover vision. Single-focus lenses, bifocal lenses, trifocal lenses, progressive multi-focal lenses, and the like are available.

Single-focus farsighted glasses are extremely suitable when close-range work is being performed, but when looking far away, the target fades and cannot be seen well. When they are worn while walking, footsteps fade and seeing becomes irregular. When ascending stairs in particular, this is unsafe because of unsure footsteps.

Bifocal lenses are divided into a far-vision lens and a near-vision lens, and are usually made so as to be portable; however, there are defects such as the facts that the border of the near-vision part is conspicuous, jumping of an image cannot be avoided, and when feet are viewed, fading and distortion result.

Trifocal farsighted glasses are meant for people who have almost completely lost the ability to adjust their eyes, and have an intermediate-vision part added to bifocal lenses so that intermediate parts can be well seen. Basically, they have the same defects as bifocal lenses.

With farsighted glasses having progressive multi-focal lenses, the boundary between the near-vision and intermediate-vision parts is connected and the inconveniences of image jumping, the border line, and the like are eliminated; however, there are defects such as the facts that the near and intermediate fields of vision are narrow, optical aberrations are significant, shaking of the image is significant, and the like.

As can be seen from the above, it is impossible to construct perfect farsighted glasses with one fixed lens where all parts of the lens are close, there is accuracy in seeing

in intermediate and far ranges, and the part of the lens and the degree of accuracy in seeing correspond with each other.

The objective of the present invention is an item where the previous defects are eliminated by electrically controlling the refractive index.

As is known in recent years, the development of non-linear optical elements has been remarkable. Many items, both solid and liquid crystal, where the refractive index is electrically changed are being developed.

However, the structure of the electronic control of the focal distance of glasses is fundamentally different than that of the automatic focus lenses of cameras, 8-mm cameras, and the like. With the automatic focus mechanisms of cameras and the like, the refractive index of the entire lens is adjusted and the focal distance may be automatically adjusted. However, in the case of farsighted glasses, when seeing in a far direction, eyesight is corrected by putting on glasses with concave lenses and when seeing in a near direction, eyesight is frequently corrected by putting on glasses with convex lenses; alternatively, when seeing in a near direction, eyesight is corrected by putting on glasses with lenses having no [illegible word], and even when the refractive rate of the entire lens for seeing in a far direction is adjusted, this is not a suitable lens for seeing in a near direction.

Therefore, it is indispensable to insert a small ball which can be electrically controlled separately from the main ball, for the near-vision and intermediate-vision parts.

A feature of the present invention is that the refractive rate of only part of the spectacle lenses is electrically controlled.

The present invention is explained specifically below.

Figures 1(a) and (b) are an example of electronic spectacle lenses. (1, 2) are lenses, (3) is a lens connection surface, and (4) is a small ball. The shape of the small ball may be any of a circle, an arch shape, an oval, a square, a polygon, a combination of straight lines and curved lines, or the like. The surface curve may be any of a sphere, a rotating ellipse, a rotating n-curved surface, or the like. In order to make the aberration of the lens small, a rotating ellipse, rotating n-curved surface, or the like is preferable. A transparent electrode is coated on the surface contacting (4) of the lenses (1, 2). These must be insulated from each other, and lead wires (5, 6) are extended by the transparent electrodes. The directions of the lead wires are not limited, but are connected to a power source for providing voltage and a current to the small ball and changing the refraction rate. A liquid crystal is inserted in the cavity part of (4), but it is preferable that the electrode undergo an addition process.

For example, para-azoxyanisol (PAA) may be filled inside the cavity (4). When voltage is added to the small ball with the refraction rate in the optical axis direction $ne$ = 1.85 and the refraction rate in the direction perpendicular to the optical axis $no$ = 1.86, the refraction rate changes to $ne - no = 0.29$. Depending on the amount of voltage, an intermediate value is adopted, and the refraction rate may be changed continuously or in stages.

Next, the dimensions, the degree of addition, and the like are mentioned. The degree of addition $D_{add}$ in the case of a thin lens is as follows:

$D_{add} = (n_2 - n_1)\,(1/r_1 - 2/r_2)$

$n_1$: refraction rate of the main ball

$n_2$: refraction rate of the small ball

$r_1$: front surface curvature diameter of the small ball

$r_2$: back surface curvature diameter of the small ball

When the diameter of the small ball is 10 mm, $n_2 - n_1 = 0.2$, and $r_2 = \infty$, the relationship between the degree of addition, $r_1$, and the core thickness of the small ball is as shown in Table 1. When the degree of addition is large, the core thickness is increased and the transparency of the liquid crystal is reduced; this also has the defect that the driving voltage is high, but when the core thickness is 0.25 mm, it is in the range of realization.

Table 1

[Translation of top row headings]

Degree of addition, D / $r_1$, mm / core thickness, mm

Next, the case of manufacturing an intermediate-vision part will be mentioned. It is satisfactory for the degree of addition to be smaller with the intermediate-vision part than with the near-vision part. Therefore, the intermediate-vision small ball has a larger curvature radius than that of the near-vision part. The positional relationship with the small ball is above the small ball; i.e., in a location near the optical core of the main ball. In ordre to minimize jumping of the image, the intermediate-vision part and the near-vision part should be connected by a continuous curved surface. In special cases such as trifocal lenses, non-continous items are also permitted.

The refraction rate of the main ball and the small ball is ideally the same when viewing in a far direction, and by adjusting the composition of the main ball and the small ball, they can be made the same. For example, a min ball iwth a refraction rate of 1.52 can be comprised of a blend of an acrylic resin and a styrol resin.

The electronic control for changing the refraction rate of the small ball may be accomplished in various ways such as by the eyeglass werer pressing a switch, carrying it out staticaly with a touch switch, carrying it out by means of a signal from an automatic distance-measuring unit, or the like. Any of these may be applied to the present invention; there is no limitation.

For the power source, silver batteries, lithium batteries, air batteries, or the like may be used. When the glasses are used in a bright place, solar batteries may be mounted and used in combination with secondary batteries such as silver batteries, llithium batteries, air batteries, nickel-cadmium batteries, nickel-zinc batteries, nickel-iron batteries, or the like.

The electronic spectacles comprising the present invention include the electronic lenses assembled and built into the shape of the frames.

The electronic spectacles of the present invention have the far-vision, intermediate-vsision, and near-vision parts used on a time-sharing basis. Defects such as aberrations when transporting, shaking of images, conspicuous border lines in the lenses, and the like are eliminated, and the practical value is extremely high.

Simple Explanation of the Drawings

Figure 1(a) and (b) is ab example of the lens of the electronic spectacles in accordance with the present invention; (4) is the near-vision (small ball) part.

Translations Branch
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CONSTITUTION: A small ball which is capable of controlling refractive indices is inserted in the near-vision part and intermediate-vision part of a spectacle lens. Namely, the small ball is inserted at the faying surface 3 of lenses 1, 2. The shape of the small ball for near-vision may be circle, segment, ellipse, etc. and its surface curve is preferably ellipsoid of revolution and surface of revolution of n-degrees, in order to reduce the aberrations of the lens. Transparent electrodes are coated on the lens 1 and 2 in contact with the small ball 4. These are mutually insulated and lead wires 5, 6 are led out from the respective transparent electrodes . The lead wires are connected to a power source which applies voltage and current to the small ball part and changes its refractive index. Liquid crystal is put in a cavity part 4. In this way, the refractive index may be changed continuously or stepwise.

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審査請求　未請求

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㊹電子メガネ

㉑特　　願　昭53—149497
㉒出　　願　昭53(1978)12月 1 日

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明　　細　　書

発明の名称

電　子　メ　ガ　ネ

特許請求の範囲

1) 近用部の屈折率が電気的に増減することを特徴とする電子メガネ。

2) 近用部の屈折率が電気的に増減するメガネにおいて、中間用部の屈折率を電気的に増減することを特徴とする電子メガネ。

発明の詳細な説明

本発明は、老視用電子メガネに係わるものであり、詳しくは近用部、中間用部の屈折率が電気的に増減することを特徴とする。

老視とは、毛様筋の緊張、弛緩による調節力が減退したため、見える範囲が限定されることをいう。具体的には、人間は40才以上になると眼の調節力が小さくなり、近部つづいて中間部は焦点が合わなくなる。



この調節力の減退を補い、視力を回復させるために通称老眼鏡がある。老眼鏡には単焦点レンズ、二重焦点レンズ、三重焦点レンズおよび累進多焦点レンズ等がある。

単焦点レンズ老眼鏡は、近用の仕事をする時には極めて都合が良いが、遠くを見ると対象がぼけて良く見えない。歩行時に掛けると足元がぼけるとともに歪んで見える。特に階段の昇降時には、足元が危く危険である。

二重焦点レンズ老眼鏡は、レンズを遠用部と近用部に分け、常時携帯できるように作られてはいるが、近用部の境界が目立つことと、像のジャンプが避けられないことと、近用部で足元を見るとぼけるとともに歪むこと等の欠点を有している。

二重焦点レンズ老眼鏡は、眼の調節力がほとんどなくなつた人用のもので、中間部が良く見えるよう二重焦点レンズに中間用を加えたものであり、基本的に二重焦点と同様の欠点を有している。

累進多焦点レンズ老眼鏡は、近用、中間用部の境界が連続的につながつており、像のジャンプ・

境界線等の不都合は無くなつたが、近用・中間用の視野が狭いこと、光学的収差が大きいこと、像の揺が大きいこと等の欠点がある。

以上から判かる通り、レンズのどの部分も近く、中間および遠くを見る確率を有しており、レンズの部分と見る確率の大きさが対応しているわけであり、一枚の固定されたレンズで、パーフエクトな老眼鏡をつくることは不可能である。

本発明の目的は、電気的に屈折率を制御することにより、従前の欠陥をなくしたものである。

周知の通り、近年、非線型光学素子の発達は著しい。電気的に屈折率が変化するものが、固体および液晶で数多く開発されている。

しかし、メガネの焦点距離の電気制御は、カメラ、8ミリカメラ等の自動焦点レンズとは、その構造が基本的に異なる。即ち、カメラ等の自動焦点機構は、レンズ全体の屈折率を増減させ焦点距離を自動的に増減させれば良いが、老視用メガネの場合、遠方を見る時凹レンズをかけ視力を矯正し、近方を見る時凸レンズをかけ視力を矯正する

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ことおよび遠方を見る時度のないレンズで近方を見る時凸レンズをかけ視力を矯正することが多く、遠方を見るレンズ全体の屈折率を増減させても近方を見るに適したレンズにはならない。

従つて、近用部・中間用部には親玉とは別に電気的に屈折率を制御できる小玉を挿入することが不可欠である。

本発明の特徴は、眼鏡レンズの一部分のみを電気的に屈折率制御をおこなうことにある。

以下に本発明につき具体的に記述する

第1図(a)および(b)は本発明になる電子メガネのレンズの1例である。1，2はレンズ、3はレンズの接合面、4は小玉である。近用の小玉の形状は円、欠円、楕円、方形、多角形および直線と曲線の組合せ等いずれでも良い。その設面カーブは球、回転楕円、回転n次曲面等いずれでも良い。レンズの収差を少なくするため、回転楕円および回転n次曲面等が好ましい。レンズ1及び2の4に接触する面に透明電極をコートする。それらは互に絶縁されてなければならず、それぞれから透

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明電極でリード線5，6を出す。リード線の方向は限定されないが、小玉部に電圧・電流を与え屈折率を変えるための電源に接続される。4のキャビテイー部には液晶が入れられるが、電極は配向処理されていることが望ましい。

例えば、キャビテイー4にパラ・アゾキシアニソール(PAA)を充填する。光軸方向の屈折率 $n_e = 1.85$，光軸と直角方向の屈折率 $n_o = 1.56$ で小玉部に電圧を加えると屈折率は $n_e - n_o = 0.29$ 変化する。電圧の大きさによつてはその中間値をとりえ、屈折率を連続的又は段階的に変えることができる。

次に小玉の寸法、加入度等について言及する。小玉の加入度Daddは薄肉レンズの場合次の通りで

$$Dadd = (n_2 - n_1)\left({}^{1}/_{r_1} - {}^{2}/_{r_2}\right)$$

$n_1$：親玉の屈折率

$n_2$：小玉の屈折率

$r_1$：小玉の前面曲率半径

$r_2$：小玉の後面曲率半径

ある。小玉の直径を10㎜，$n_2 - n_1 = 0.2$，$r_2 =$

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∞とすると加入度、$r_1$，小玉の中心厚の関係は第1表となる。加入度が大きくなると、中心厚が増し液晶の透明性が低下し、さらに駆動電圧が高くなる欠点を有するが、中心厚が0.25㎜程度では実用範囲にある。

第　1　表

| 加入度　D | $r_1$　㎜ | 中心厚　㎜ |
|---|---|---|
| 1.00 | 200 | 0.06 |
| 2.00 | 100 | 0.13 |
| 4.00 | 50 | 0.25 |

次に中間用部をつくる場合について言及する。中間用は近用より加入度は小さくて良い。従つて中間用の小玉は近用より曲率半径を大きくする。小玉との位置関係は、小玉より上即ち親玉の光学中心に近い所にあり、像のジヤンプを小さくするため中間部と近用部は連続曲面で接続されるべきである。特殊な場合、三重焦点レンズの如く不連続になることも許される。

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親玉と小玉の屈折率は、遠くを見る時同一であることが理想的で、親玉の組成と小玉の組成をそれぞれ調節することにより同一にする。例えば、屈折率が1.52の親玉はアクリル樹脂とスチロール樹脂とのブレンドによりできる。

小玉部の屈折率を変える電気制御は、スイッチを眼鏡携帯者が押すこと、又はタッチスイッチで静電的におこなうこと、自動距離測定ユニットからの信号によりおこなうこと等各種あるが、本発明はいずれでも良く、これによる限定されない。

電源には、銀電池、リチウム電池、空気電池等が適している。眼鏡は明るい所で使用する故、太陽電池を装着し、銀電池、リチウム電池、空気電池、ニッケル－カドミニウム電池、ニッケル－亜鉛電池、ニッケル－鉄電池等の二次電池と組合せて用いると電池を小型化できる。

このような電子レンズをフレームの形状に加工し組み込んだものが、本発明になる電子メガネである。

本発明の電子メガネは、遠用、中間用、近用を



それぞれタイムシェアリングにより使い分けたものであり、携帯時の収差、像の揺れ、レンズの境界線の目立ち等の欠点を除去したもので、その実用価値は極めて大きい。

図面の簡単な説明

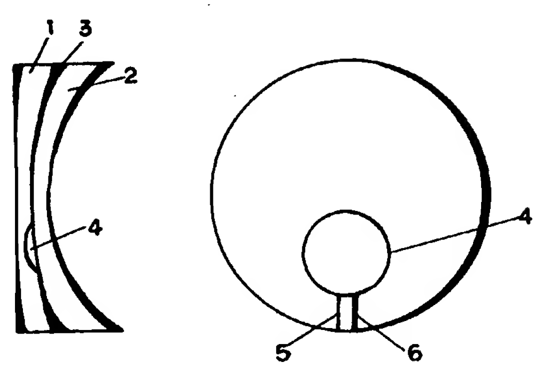
第1図(a)および(b)は本発明になる電子メガネのメガネレンズの1例であり、4が近用（小玉）部である。

以上

出願人　株式会社諏訪精工舎

代理人　最上　務






(a)　(b)

第1図